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A Structural Relationship of Work Stress, Smoking, Drinking and Mental Health

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ABSTRACT

A Structural Relationship of Work Stress, Smoking, Drinking and Mental Health

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Introduction : Workplace is one of the most influential environment in one's life. The mental health of Korean workers are threatened by the high levels of work stress that they are known to experience. Moreover, the working population of Korea tend to engage in health-risk behaviors based on the strong belief that smoking and drinking can serve as an anti-anxiety agent. So far, findings on the magnitude and direction of the relationships between work stress,

health-risk behaviors and mental health have been inconsistent. Structural equation modelling, which is a latent variable model, has the ability to unmask the hidden relationships between variables by taking account of unobserved heterogeneity in participants. This study aims to identify the relationships between work stress, health-risk behaviors and mental health by using a structural equation model to achieve mental and physical well-being of the working population.

Methods : Statistical analyses were conducted on a subset of the Third Korean Working Conditions Survey (2011). Two different models have been implemented to address more accurate relationships between the study variables. Research model 1 suggested a mediation model with work stress as an independent variable, health-risk behaviors as a mediating variable and mental health as a dependent variable. Research model 2 suggested a recursive model (work stress → mental health → health-risk behaviors → work stress). Confirmatory factor analysis was applied and path analyses were conducted for each of the research model. Also, in order to measure the indirect effect of work stress on mental health, mediation analysis through bootstrapping has been applied.

Results : Work stress appears to be a significant determinant of poor mental health conditions among men in both research model 1 (β =-0.59) and research model 2 (β=-0.61) at $p<0.001$. The relationship between work stress and health risk behaviors were found to be only

significant among men in research model 1 (β=0.08). On the other hand, high intensity of health-risk behaviors is related to poor mental health in both men (β=-0.16) and women (β=-0.29) at $p<0.001$ and $p<0.05$ respectively. The pathway of the opposite direction predicting high intensity of health-risk behaviors as an outcome of poor mental health condition was also found be significant among men (β=-0.20). In research model 1, the indirect effect of health-risk behaviors in the relationship of work stress and mental health was found to be significant at $p<0.05$.

Conclusion : To efficiently target for the work-related stress of the Korean employees, perceptions of health-risk behaviors as means of stress relief agents must be changed. In addition, appropriate stress coping strategies based on the characteristics of employees must be developed and applied to improve both mental and physical health status of workers.

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Keyword : Work stress, Health-risk behaviors, Smoking, Drinking, Mental health, Structural Equation Model

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1. INTRODUCTION

1.1 Background

One's work environment plays a key role in life, since it brings benefits such as; social inclusion, opportunity to fulfill one's aspirations and feelings of self-worth and revenue to sustain living. Therefore, stress from work is perceived to be critical than any other form of stressors. Yet, profound changes in and around work organizations have increased psychosocial workload to a large extent. The nature of work these days have shifted from physically demanding kind to mentally and emotionally demanding kind. Such changes can pose serious threat to the mental well-being of workers.

Korean workers, in particular, are believed to be more vulnerable regarding mental health. They are known to suffer from long working hours, socializing after work and frequent work performance evaluations. Consequently, they experience high level of work stress, having the second highest degree of work stress level among OECD countries (International Research Group, 2013). While an adequate amount of stress can motivate workers for greater achievements, excessive work-related stress has predicted increased risks of physical and psychological health outcomes. The physical health outcomes may include high blood pressure, high cholesterol and cardiovascular diseases (Johnson & Hall, 1988; Niedhammer et al., 1998).

Furthermore, work stress may elicit depression and anxiety (Stansfeld & Candy, 2006).

Although the concept of stress itself is very popular, it has been difficult to agree on an universally accepted definition of stress. Work stress has been defined in various ways by several institutions. For instance, the National Institute for Occupational Safety and Health (NIOSH) refers to work stress as 'harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the worker.' (National Institute for Occupational Safety & Health, 1999). Also, the Health and Safety Commission of United Kingdom defines work related stress as 'the adverse reaction people have to excessive pressures or other types of demand placed on them at work' (Health and Safety Commission, 1999).

A number of theoretical frameworks have been introduced to address the effect of work stress on workers' health (Azagba & Sharaf, 2011). Karasek's job demand-control model (Karasek Jr, 1979) and the Effort-reward imbalance (ERI) at work model (Siegrist, 1996) are the most dominant models investigating the relationship between work-related psychosocial factors and health for several decades. The job demand-control model suggests that high job demand and low job control (high job strain) can have detrimental effect on health. In the 1980s, social support was included to the model by Johnson and Hall, expanding it to the demand-control-support model (DCS model).

According to the modified model, work-related social support has the ability to buffer the negative effects of job strain among workers (Johnson & Hall, 1988). On the other hand, the ERI model introduces work stress as an imbalance between excessive commitment of the worker and low rewards received. The model focuses on the negative emotions that are induced when people are not appreciated adequately (Siegrist, 1996). Sustained stress reactions due to the lack of reciprocity can increase disease susceptibility of workers (Siegrist & Rödel, 2006).

What is interesting here, is that even under same stressful conditions, each individual react differently. It is because stress reactions are induced in the situation where demands of the work exceed the employee's ability to manage or control them (Aldwin & Revenson, 1987). This implies that not only the stressor itself, but the ability to deal with stress is critical. Past studies have shown that coping to stress is associated with mental health status. Stress and coping style are known to be responsible for about 50 percent of the variance in mental health (Aldwin, 1991;Aldwin & Revenson, 1987;Folkman, Chesney, Pollack, & Coates, 1993). Taking structural measures, such as task redesigning, setting organizational justice or changing work conditions and social conditions at work are practically impossible. Therefore appropriate work-related stress coping strategies must be developed.

The working populations of Korea are known to engage in

behavioral measures such as alcohol drinking and cigarette smoking to cope with stress (Lee, 2007). This is due to the widely spread belief that drinking and smoking is effective in terms of relieving stress (Han, Ko, Kim, Kim, & Kim, 2007; Park & Lee, 2005). A desirable outcome of coping would be to promote, or at least maintain not only mental but also physical health. However, empirical evidences on the relationship between health-risk behaviors and mental health are somewhat inconclusive (Siegrist & Rödel, 2006). Furthermore, harmful health effects from tobacco smoking and excessive alcohol consumption are thoroughly documented in literatures. According to the Surgeon General's report (US Deparment of Health and Human Services, 2014), tobacco smoking is a major risk factor for chronic diseases and leading cause of preventable premature death. Also, one of the highest contributions to the public health burden all around the world comes from tobacco smoking (Forey, Thornton & Lee, 2011). Alcohol abuses also have enormous health effects. Too much alcohol use can lead to chronic diseases such as cardiovascular diseases, malignant neoplasms and can increase the risk of accidents (Azagba & Sharaf, 2011;Cargiulo, 2007).

This study assumes that the mixed results found in studies that explored the relationship of work stress, health-risk behaviors and mental health may be partly due to ignoring the non-observed characteristics of subjects. Previous studies have generally used traditional regression models; however, factors affecting one's behavior

are extremely diverse and complicated that standard models cannot fully capture the difference occurring due to unobserved variables (Arnold, 2006). A solution to solve this matter may be using a latent class framework. In contrary to standard models, latent variable models take account for the unobserved heterogeneity between participants. The structural equation model (SEM) is one of the most well-known latent variable models. Simply put, SEM is a methodology used to estimate and test a network of relationships between observed variables and latent constructs. Confirmatory factor analysis and path analysis are the two main constructs of structural equation modeling. This highly flexible statistical method has the ability to unmask the relationships between variables by allowing researchers to consider the imperfectness of the data they collect (Suhr, 2006).

1.2 Literature review

1.2.1 Work stress and mental health

Findings from former studies identifying the impact of work-related stress on mental health show relatively consistent results. Generally, stressful work conditions predict poor mental health outcomes. Workers who reported high levels of work stress showed elevated rates of depressive symptoms (Clays et al., 2007;Melchior et al., 2007). For example, a longitudinal study of 972 participants in New Zealand showed a twofold risk of major depressive disorder in high job demand group compared to the low demand group (Melchior et al., 2007). Another ill mental health outcome resulting from work stress is sleep disorder. Nakata et al. (2007) examined the cross-sectional association between insomnia and work-related stress among workers in Japan (Nakata et al., 2007). Factors such as low social support and low job satisfaction significantly increased the risk of insomnia. Stressful work environment can also predict burnout, which can be characterized by emotional exhaustion and cynicism (Freudenberger, 1974).

1.2.2 Work-related stress and health-risk behaviors

Although many studies have tried the measure the impact of job stress on health-risk behaviors, the associations differ in direction and magnitude. Former researches, mainly focused on the demand-control model, suggest contradictory findings with positive, negative and null-associations (Siegrist & Rödel, 2006). In some studies, high job strain is positively associated with smoking status (Kouvonen, Kivimäki, Virtanen, Pentti, & Vahtera, 2005) and smoking intensity (John, Riedel, Rumpf, Hapke, & Meyer, 2006;Kuper & Marmot, 2003), while others suggest that high smoking prevalence or smoking intensity is associated with high job demand (Hellerstedt & Jeffery, 1997) or low job autonomy only (Otten, Bosma, & Swinkels, 1999). Some studies failed to predict the association between job strain and smoking (Shields, 1999;Steptoe, Wardle, Pollard, Canaan, & Davies, 1996). As the smoking initiation age is generally earlier than the point of joining the labor market, the relationship between work stress and smoking is reflected on the intensity of tobacco smoking, rather than the status of smoking (Green & Johnson, 1990; Greenlund et al., 1995; Johnson & Hall, 1988; Niedhammer et al., 1998).

Findings from studies, that have investigated the impact of work stress on alcohol intake are similarly mixed (Siegrist & Rödel, 2006). Several studies found positive association between work stress and alcohol consumption (Kuper & Marmot, 2003;Romelsjö et al.,

1992;San Jose, Van Oers, Van De Mheen, Garretsen, & Mackenbach, 2000). A longitudinal study found a clear relationship between stressful work and alcohol-related problems among males (Romelsjö et al., 1992). Also, a cross-sectional study conducted in the Netherlands reported that workers who claim high job demands were more likely to binge drink (San Jose et al., 2000). On the contrary, female workers residing in London, with low job demands and low job control were less likely to drink heavily. Employees of Helsinki and Japan showed no significant association between work stress and alcohol drinking (Lallukka et al., 2008).

1.2.3 Health-risk behaviors and mental health

Bidirectional mechanisms for this kind of association have been suggested. In some part, cigarette is perceived as an anti-anxiety agent among workers (Mensch & Kandel, 1988). Workers believe that smoking soothe their emotions and increase work productivity by enhancing concentration (Han et al., 2007). Some researchers argue that the acute pharmacological effect of nicotine can play a role in regulating negative emotion (Kassel & Unrod, 2000). In contrast, some studies found that tobacco use can serve as a stress-inducing agent (Han et al., 2007;Parrott, 1999). The repetitive distress due to nicotine deficiency between events of smoking can actually cause

more stress (Parrott, 1999).

The same applies for alcohol use. On one hand; Conger's (1956) tension-reduction theory implies that consuming alcohol under stressful conditions reduces the physiological impact of stress (Conger, 1956). Alcohol consumption is influenced by interaction of complex factors and it is likely to be used in an attempt to avoid stress (Cooper, Russell, Skinner, Frone, & Mudar, 1992). On the other hand, there are views that see psychological symptoms as a consequence of problematic alcohol use. Excessive drinking of alcohol can change the workers' perception of working conditions, making them to think that the psychosocial work conditions are more stressful than before (Cargiulo, 2007). The risk of depression development after alcoholism is higher than that of risk of alcoholism development after depression onset (Gilman & Abraham, 2001;Kessler et al., 1997)

1.3 Objectives

The ultimate goal of this study is providing evidence for developing appropriate stress coping strategies through changing the perspectives of coping strategies among the working populations of Korea. Objectives of this study are as follows:

First, confirming the relationship between work stress and mental health

Second, identifying the relationships between work stress and health-risk behaviors

Third, investigating the effect of health-risk behaviors (alcohol drinking and cigarette smoking) on the relationship of work stress and mental health.

2. METHODS

2.1 Data sources

Data of this study were derived from the Third Korean Working Conditions Survey (KWCS), which was conducted in 2011. 50,032 workers were surveyed by the Korea Occupational Safety and Health Agency (KOSHA) in total. The Korean Working Conditions Survey is a nationwide and representative survey with a cross-sectional nature. A two stage stratified probability proportional to size systematic method was applied as a sampling design of this survey. The KWCS aims to identify health risk factors among work environment and monitor trends in work environment. The target population of the third KWCS can be defined as “all economically active population aged 15 years and over, residing in a household of Korea at the point of the survey” However, residents of islands, dormitories, special welfare institutions, tourist hotels, and foreigner enumeration districts were excluded from the survey population due to practical issues. All information of the survey were gathered through face-to-face pen and paper interviewing system (PAPI).

Employers (N=3,831), own-account workers (N=13,674), unpaid family workers (N=1,829) and other types of workers (N=987) (e.g. economically dependent workers) were excluded from the final

analysis concerning their different characteristics from paid-workers. The impact of work stress on smoking and drinking intensity is regarded to be more informative than the status of smoking and drinking, since these habits are normally initiated before entering the labor market (Green & Johnson, 1990; Greenlund et al., 1995; Johansson, Johnson, & Hall, 1991; Niedhammer et al., 1998). Also, a prospective study of Finland suggested that work stress reduces the likelihood of quitting smoking (Kouvonen et al., 2009). This result implies that current smokers are more likely to be under more stressful working conditions than those who have succeeded in quitting smoking during the past years. Therefore, in order to avoid the risk of selection bias, a total of 21,071 subjects, which were non-smokers, non-daily smokers and non-drinkers were excluded from this study. The final subjects of this study included 8,062 men and 578 women from the Third Korean Working Conditions Survey.

2.2 Measures

2.2.1 Work Stress

Dimensions of work stress were constructed based on the domains of the Job Content Questionnaire (JCQ) (Karasek et al., 1998). The Job Content Questionnaire is an instrument used in the assessment of work conditions. None of the questions involved in the Korean Working Conditions Survey were original measures of the JCQ; however, similar variables were adapted.

Five indices (psychological job demands, decision latitude, social support, physical job demands and job insecurity) were constructed. First, Psychological job demands include the following six items: working at very high speed, working to meet tight deadlines, not having enough time to finish tasks, tasks that conflict with personal values, interruption during tasks due to take on an unforeseen tasks and pace of work determined by coworkers. Decision latitude was identified through two domains, in the skill discretion domain, three items were included : learning new things at work, doing repetitive tasks in the cycle of one minute and ten minutes. Also, in the decision authority domain, 5 variables were included: applying own ideas at work, ability to choose or change the order of work, ability to choose or change the method of work, the ability to choose or change the speed or rate of work and having influence on decisions

that are important. Social support was measured through the following five indicators : getting help and support from superiors if needed, superior's ability to plan and organize work, feeling at home in the organization, having good friends at work and getting help and support from colleagues if needed. Physical job demand was defined by three items: lifting heavy loads, tiring or painful positions and repetitive hand or arm movement. Finally, job insecurity was explained through two measures – expectation to lose the current job within 6 months and bad prospective for career development. Each items were summed up to represent the five domains or work stress – psychological job demand, decision latitude, social support, physical job demand and job insecurity.

2.2.2 Health-risk behaviors

Two self-reported health behavior indicators, daily smoking intensity and alcohol consumption amount, were chosen as mediators for this analysis. Daily smoking intensity was measured by asking "On average, how many cigarettes do you smoke per day?" Alcohol consumption was identified using these two questions: 1)"On average, how often do you drink alcohol?" The response scale was 1=more than four times per week, 2=two to three times per week, 3= two to four times per month, 4=less than one time per month 2)"On the days that you drank, how many drinks did you usually have?" The

response scale for this question was 1=one to two cups of soju (Korean alcoholic beverage), 2=three to four cups of soju, 3=five to six cups of soju, 4=seven to nine cups of soju, 5= more than ten cups of soju. For calculating average alcohol consumption amount per day, the quantity frequency (QF) method was used. The median of the response scale was used to estimate the quantity and frequency of alcohol consumption. For example, if the respondent reported to drink two to four times every month, and claimed to drink three to four cups of soju every time he/she drank, $\frac{3}{30}$ (alcohol consumption frequency per month) was multiplied by 3.5 (consumed cups of soju). Assuming that each cups of soju has 10 grams of alcohol, the obtained value was multiplied once more by 10 to obtain the amount of alcohol drank per day.

2.2.3 Mental health

Mental health was measured using the WHO-Five Well-being Index (WHO-5), which was developed from the WHO-10 Well-being Index (Bech, Olsen, Kjoller, & Rasmussen, 2003). This scale of five questions is a brief, validated self-rating instrument for screening out depression. The WHO-Five Well-being Index covers mood, interest and energy, which are three core items of depression. The index contains five positively worded questions. “I have felt cheerful and in

good spirits", "I have felt calm and relaxed", "I have felt active and vigorous", "I woke up feeling fresh and rested" and "My daily life has been filled with things that interest me." Each question assessed the condition in the past two weeks on a six-point Likert scale (0: not present, 5: always present). The raw scores are transformed to a range of 0-100 by multiplying 4. It has been suggested that score of 50 or less indicates poor emotional well-being and a score of 28 or less indicates depression. The WHO-five Well-being Index is useful because it can measure an overall state of well-being, rather than merely the absence of psychological symptoms (Bech et al., 2003).

2.2.4 Other variables

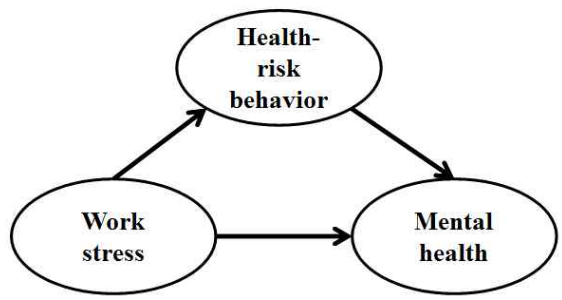
General characteristics such as age, educational level, income described by sex in the analysis. Age was divided into 4 groups (15-19 years, 19-45 years, 45-64 years, ≥65 years), considering the social positions of the workers. As for the educational level, subjects were subgrouped based on the length of years they have received education. Those that have not finished elementary education were classified into <6 years. In addition, those that have at least graduated elementary school or have attended middle school were classified into the 6-9 years group. Middle school graduates were classified into 9-12 years group. Those who graduated high school or more were

classified as ≥12 years group. Monthly income after taxes was classified into less than 1 million won, 1 to 2 million won, 2 to 3 million won, 3 to 4 million won and more than 4 million won.

Work-related characteristics such as occupational class, employment status and weekly working hours were also collected from the Korean Working Conditions Survey. As for the occupational class, the subjects were divided into 4 categories (Choi & Ha, 2009). Based on the classification of the Korean standard classification of occupations, administrators and professionals were classified into “high-skilled non-manual” and clerical workers were classified into “moderate skilled non-manual” Those workers who engage in manual work such as sales, service, agricultural/fishery/forestry workers, craft workers and machine operators were classified as “moderate-skilled manual” Laborers were assigned to “low-skilled manual” Employment status was divided into three groups; employees who are contracted to work for less than one month were classified as non-standard (<1 month) and those who are contracted for more than one month but less than 12 months at most were assigned to the non-standard (1 month-1 year) worker group. On the other hand, workers who are contracted to work for more than 12 months or have no contracted limits in work period were assigned to the standard worker group. Working hours per week was divided by a cut point of 40 hours, as the Korean Labor Standards Act states that weekly working hours should not exceed 40 hours.

2.3 Study design

Based on the previous literatures, two research models have been suggested to identify the relationships between work stress, health-risk behaviors and mental health.



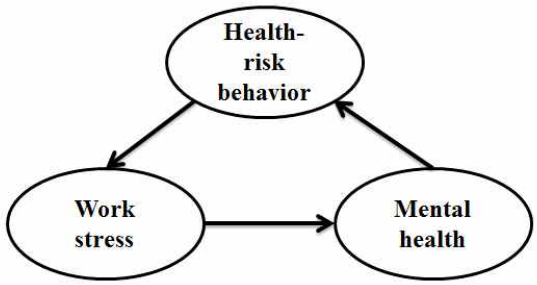
<Figure 1. Research model 1>

According to the research model 1 in Figure 1, the hypotheses of this study are as follows:

1-1. Workers with high work stress can be predicted with poor mental-health condition

1.2. Workers undergoing high work stress are more likely to engage in health-risk behaviors (cigarette smoking and alcohol drinking).

1-3. High intensity of health-risk behaviors (cigarette smoking and alcohol drinking) can have a significant association with poor mental health.



<Figure 2. Research model 2>

On the other hand, the second research model suggests different directions between study variables. The research hypothesis based on the research model 2 are as follows:

2-1. Workers with high work stress can be predicted with poor mental-health condition.

2-2. Poor mental health can make workers to engage more in health risk behaviors, represented by smoking and drinking

2-3. Workers who engage highly in health risk behaviors (cigarette smoking and alcohol drinking) are more likely to feel stress from work.

2.4 Statistical analysis

The statistical analyses of this study were performed using statistical software R, version 3.2.2 (R Core Team, 2015) mainly by the package lavaan (version 0.5-19). The lavaan package is a user-friendly software which allows for latent variable modeling (Rosseel, 2012).

The analysis procedure is as following:

(1) Design considerations

(2) Descriptive statistics

(3) Confirmatory factor analysis

(4) Path analysis

(5) Mediation analysis

2.4.1 Design considerations

Structural Equation modeling approach was applied to investigate the relationship between work stress, smoking, drinking and mental health. Before conducting an analysis based on structural equation modeling, several criteria such as sample size, data structure (multivariate normality, outliers, and missing data), parameter estimation method and model fit indices must be considered.

First, to use the ML (maximum likelihood) estimation, which is a default method for most of the model-fitting programs, the assumption of normality must be made. The maximum likelihood estimation makes normal distributional assumptions of the endogenous variables (Hoyle, 2012). Normality of the data can be tested through checking the asymmetry (skewness) and the peakedness (kurtosis) of a distribution. Typically, skewness or kurtosis of zero indicate normality. However, data on human behaviors are often difficult to be distributed normally because only a limited number of answers can be obtained. In that case, estimators from the WLS (weighted least squares) family are needed. Weighted least squares method does not assume a particular form of distribution; therefore, it can be used on non-normal data (Kline, 2011). Generally, skewness exceeding the absolute value of 2 and kurtosis exceeding the absolute value of 7 is considered extreme when applying structural equation model (West, Finch, & Curran, 1995). The skewness of the variables used in the

study did not exceed 1.80 and the kurtosis did not exceed the absolute value of 3.49. In addition, the data must be consisted of endogenous continuous variables to use ML estimation. The endogenous variables used in this study are work stress, health-risk behaviors and mental health for research model 1 and work stress, health-risk behaviors and mental health for research model 2. These variables are all in continuous form. Therefore, application of maximum likelihood as an estimate parameter method is considered appropriate.

The second assumption that must be met is that there must be no missing data when conducting SEM. Missing values must be dealt by deleting the missing case from data or replacing the missing values. There were 89 missing data in the monthly income variable, therefore, mean of the total monthly income of study participants were calculated to conduct mean imputation. Also, no outliers were identified from the variable used in this study.

The number of samples needed in a structural equation model is usually dependent on the complexity of the model, number of observed variables, the method of estimation and the amount of missing data in the model (Hair, Black, Babin, Anderson, & Tatham, 2006). Although there is no fixed recommendation on the ideal sample size in the structural equation model, a number of suggestions on suitable sample size have been made by researchers. For example, Jöreskog and Sorbom suggested approximately 200 samples for studies

with less than 12 observed variables and 1.5*(N of observed variables)*(N of observed variables+1) for those with more than 12 observed variables (Jöreskog & Sörbom, 1989). In general, structural equation model seems to perform well for sample sizes over 200. In this study, more than 8,000 samples were used for one group (men) and over 500 samples for another (women).

Whereas the traditional model specifies a default model, SEM cannot give a default model. Instead, it provides several statistical strategies to evaluate model fit. One of the most frequently used model fit index is the $\chi 2$ test, which is an absolute measure of model fit. $\chi 2$ value near zero suggests that there are little difference between the observed model and the expected model. Model fit is supported in the chi-square statistics when there is no significant difference between the null model and the hypothesis model. Nevertheless, in spite of its frequent use, chi-square tests may be unsuitable for studies with large number of participants because it is extremely sensitive to the size of the sample. Therefore, other fit measures are recommended to use along with $\chi 2$ measures. The overall model fit can be assessed through measures such as root mean-squared residual (RMSR) and Root Mean Squared Error of Approximation (RMSEA) index. Absolute fit indices represented with $\chi 2$, RMSR and RMSEA assess model fit without any comparisons. While RMSR under 0.05 is considered acceptable, RMSEA under 0.01, 0.05 and 0.08 each indicate excellent, good and acceptable fit (Hu & Bentler, 1999).

Compared to the chi-square statistic, RMSEA is relatively insensitive to large sample sizes. Incremental fit indices or in other words, relative fit indices evaluate model fit by comparing the null model with the alternative model. Examples of incremental fit indices are comparative fit index (CFI), normed fit index (NFI) and Tucker-Lewis index (TLI). CFI, NFI and TLI range from 0 to 1, and CFI, NFI and TLI value of 0.9 or more indicate acceptable model fit (Hu & Bentler, 1999). Another type of model fit index is the parsimonious fit index. The parsimonious fit indices provide information of the best model while considering the complexity of the model. When comparing the model fits of the same data, Akaike's Information Criterion (AIC) or Bayes Information Criterion (BIC) can be used. Lower values if Akaike's information criterion suggest better model fit. Uses of multiple model fit measures are often recommended because together, different indices can provide complementary information.

2.4.2 Descriptive statistics

Descriptive statistics analysis for 8,640 (8,062 men and 578 women) participants were performed and presented. Distributions of general characteristics and work-related characteristics such as age, educational level, monthly income, occupation, employment status and weekly

working hours were identified. Also, mean, standard deviation, minimum value, maximum value, skewness and kurtosis of the observed variables included in this study were identified to assess the data structure of this study.

2.4.3 Confirmatory factor analysis

Multi-group confirmatory factor analysis (MG-CFA) was applied to validate the structures suggested in the model, while considering the difference between men and women. Initially, confirmatory factor analysis was conducted to examine the appropriateness of the measurement model. Although there were two research models used in this study, confirmatory factor analysis was performed only once, since the constructs of the two models were identical. In this study, a total of 5 model fit indices (χ2, CFI, TLI, NFI and RMSEA) were used to assess if model was well-fitted in the confirmatory factor analysis.

2.4.4 Path analysis

After measuring the construct validity of the study variables, structural equation modeling was applied to test a network of relationship of work stress, health-risk behaviors and mental well-being. Multi-group

structural equation modeling approach was implemented to investigate the difference regarding sex. $\chi 2$, CFI, TLI, NFI and RMSEA indices were applied to confirm model fit. Then, path coefficients and the significance of Z-scores were evaluated. Paths with p-value<0.05 were considered as significant. Both of the non-standardized path coefficients and standardized coefficients were presented. Pathways from covariates such as age, educational level, income, occupational class and weekly working hours to the latents variables (work stress, health-risk behaviors and mental health) were included in the structural equation model to control for the potential confounding factors.

2.4.5 Mediation analysis

To measure the direct and indirect effect of work-related stress on mental health, mediation analysis was conducted. In the traditional model, the effect of mediation is calculated by going through some steps suggested by Baron & Kenny (Baron & Kenny, 1986). First, X (independent variable) affecting Y (dependent variable) directly must be confirmed. Then, the indirect effect of X on Y, through a mediator M, must be examined. In a structural equation model, all of these three paths are fitted together at once, allowing efficient estimation for these kinds of relationships.

In order to examine indirect effects in structural equation modelling, bootstrapping method is applied. The use of bootstrap method to calculate the confidence intervals in the mediation model has been recommended (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Bootstrapping is a procedure of repetitively choosing random samples with replacement from a dataset; consequently, the original dataset substitute as a populational data. Through this process, standard error can be estimated (Efron, 1981). Bootstrapping is effective to use when the distribution of the data is unknown or if assumptions of the distribution, such as normality, have been violated. Typically, resampling is conducted from 1,000 times to 10,000 times. In this study, 1,000 replacements were done.

3. RESULTS

3.1 General characteristics of the study population by sex

Table 1 gives the general characteristics of the study population by sex. All participants were employees residing in Korea, aged 15 or more. The total number of participants for men was 8,062 and 578 for women.

For socioeconomic characteristics, age, educational level, and monthly income were presented. For age, the highest proportion of the working population was in the age group of 20-44 for both men and women, followed by 45-64, 65 years old or over and 15-19. There were more young-aged workers in women. Along with the increase of educational level in years, the number of study subjects increased. In both sex, approximately 90% of the total participants received education for 9 years or more. Also, monthly income distribution among subjects were identified. There was a substantial difference between men and women regarding distribution of the income. While the highest proportion (38.25%) of men earned 2,000,000-3,000,000 won per month, more than half (50.17%) of women earned 1,000,000-2,000,000 won per month. Also, those who earned less than 1,000,000 won per month accounted for 4.52% in men, showing the lowest proportion. However, in women, those who earned 4,000,000

won per month accounted for the lowest proportion group. The proportion of women making the salary of less than 1,000,000 per month was 10.21%.

Moreover, occupational class, employment status and weekly working hours were obtained to identify the distribution of work-related characteristics. As for the occupational class, moderate-skilled manual workers accounted for more than half of the subjects in both men (50.81%) and women (52.25%) followed by moderate skilled non-manual workers (20.80%), low-skilled manual workers (14.61%) and high-skilled non-manual workers (13.78%) for men and moderated skilled non-manual (25.95%), high-skilled non-manual (11.25%) and low-skilled manual (10.55%) for women. Standard workers were the majority of the employment status, exceeding 80% of the study participants in men and exceeding 75% of the study participants in women. The proportion of workers who were contracted to work for less than a month was higher in men. On the other hand, the proportion of non-standard workers who are contracted for more than 1 month and less than a year was higher in women. Among the subjects of this study, 68.17% of employees who are men worked for more than 40 hours per week and 63.84% of total women worked for over 40 hours per week.

Table 1. General characteristics of study subjects by sex

Variables	Total (N=8,640)		Men (N=8,062)		Women (N=578)	
	N	(%)	N	(%)	N	(%)
Age						
15-19	60	0.69	52	0.65	8	1.38
20-44	5509	63.76	5084	63.06	425	73.53
45-64	2871	33.23	2742	34.01	129	22.32
≥65	200	2.31	184	2.28	16	2.77
Educational level (years)						
<6y	27	0.31	22	0.27	5	0.87
6-9	749	8.67	692	8.58	57	9.86
9-12	3721	43.07	3487	43.25	234	40.48
≥12	4143	47.95	3861	47.89	282	48.79
Income†						
<100	423	4.90	364	4.52	59	10.21
100-200	2796	32.36	2506	31.08	290	50.17
200-300	3229	37.37	3084	38.25	145	25.09
300-400	1442	16.69	1394	17.29	48	8.30
≥400	750	8.68	714	8.86	36	6.23
Occupational class‡						
High-skilled non-manual	1176	13.61	1111	13.78	65	11.25
Moderate-skilled non-manual	1827	21.15	1677	20.80	150	25.95
Moderate-skilled manual	4398	50.90	4096	50.81	302	52.25
Low-skilled manual	1239	14.34	1178	14.61	61	10.55
Employment status						
Non-standard (<1 month)	603	6.98	568	7.05	35	6.06
Non-standard (1 month - 1 year)	920	10.65	827	10.26	93	16.06
Standard	7117	82.37	6667	82.70	450	77.85
Work hours/week						
≤40	2775	32.12	2566	31.83	209	36.16
>40	5865	67.88	5496	68.17	369	63.84

† : Monthly income unit : 10,000 won

‡ : High-skilled non-manual : administrators and professionals

Moderate-skilled non-manual : clericals

Moderate-skilled manual : sales, service workers, craftworkers, machine operators

Low-skilled manual : elementary workers

3.2 Descriptive statistics of the observed variables

In table 2, descriptive statistics of the observed variables in the structural model have been presented. In the mental health domain, all five variables ranged from minimum 0, to maximum 5. The mean of the variable in the mental health domain were all in the range of 2.47-2.86 and the standard deviation of the five variables were in the range of 1.16-1.29.

Alcohol drinking intensity and cigarette smoking intensity, constructed as health-risk behaviors, had the largest mean and standard deviation values among all of the study variables. The mean of alcohol drinking intensity was 16.53 grams of alcohol per day whereas the mean of cigarettes smoking intensity was 15.11 cigarettes per day. Standard deviation of alcohol drinking was 17.05 and 6.80 for cigarette smoking. The values of alcohol drinking ranged from 0.3 grams to 79 grams per day. Cigarette smoking amount per day ranged from 1 cigarette to 60 cigarettes (3 packs). While the skewness of the two health-risk behavior variables did not exceed 2, the kurtosis was 3.49 and 3.37 for alcohol drinking and cigarette smoking.

Five observed variables, psychological job demand, decision latitude, social support, physical job demand and job insecurity was constructed to measure the extent of work stress. The degree ranged from 0 to 21 for psychological demand. The mean and standard deviation of psychological job demand were 7.86 and 3.87 each. 0

to 14 for decision latitude, 0 to 11 for social support, 0 to 18 for physical demand and 0 to 2 for job insecurity. As for the normality test for the five variables constructing work stress (psychological job demand, decision latitude, social support, physical job demand and job insecurity), the skewness ranged from –0.03 to 0.72 and kurtosis ranged from –0.50 to 0.09.

Table 2. Descriptive statistics of the observed variables

Variables		Mean	sd	Min	Max	Skew	Kurt
Mental health	Cheerful and in good spirits	2.81	1.16	0	5	-0.31	-0.71
	Calm and relaxed	2.86	1.19	0	5	-0.27	-0.73
	Active and vigorous	2.79	1.23	0	5	-0.23	-0.77
	Fresh and rested	2.57	1.27	0	5	-0.15	-0.83
	Daily life filled with interesting things	2.47	1.29	0	5	-0.06	-0.87
Health-risk behaviors	Alcohol drinking (gram/day)	16.53	17.05	0.3	79	1.80	3.49
	Cigarette smoking (cig/day)	15.11	6.80	1	60	0.89	3.37
Work stress	Psychological job demand	7.86	3.87	0	21	0.61	-0.06
	Decision latitude	6.00	2.43	0	14	-0.03	-0.47
	Social support	4.00	2.36	0	11	0.72	0.06
	Physical job demand	6.23	4.07	0	18	0.64	0.09
	Job insecurity	0.46	0.56	0	2	0.72	-0.50

3.3 Confirmatory factor analysis for the measurement model

3.3.1 Confirmatory factor analysis of variables in men

Before conducting a path analysis using structural equation modeling, a construct validity test for the measurement model was performed. This procedure is needed before running a path analysis to confirm the appropriateness of the measures used in this study. Through confirmatory factor analysis, any existence of extreme errors, negative error variance or high correlation between estimates can be uncovered.

As for the model fit statistics, CFI was 0.92, TLI was 0.90, NFI=0.92 and RMSEA statistics had the value of 0.082 with confidence interval of 0.079 and 0.084. While CFI and NFI showed acceptable model fit, TLI model fit index and RMSEA statistics did not show acceptable model fit.

To increase the model fit of the data, factor loadings of each latent variables were investigated. In table 3-1, the results of the confirmatory factor analysis presented. Pathway estimates for all of the observed variables were found to be significant at $p<0.001$.

In general, variables with non-significant z value (Straub et al., 2004), low r-square (Hooper et al., 2008) or factor loading<0.50 (Bagozzi et al., 1998), is eliminated from the model to achieve

construct validity unless removing an observed variable of low factor loading changes the overall meaning of the latent variable (Woo, 2012). All constructs of mental health had high factor loadings ranging from 0.81-0.87. However, cigarette smoking in the health-risk behaviors domain and several variables in the work stress domain presented a factor loading of less than 0.5. Nevertheless, cigarette smoking was not omitted from the whole model because it is one of the core constructs of the latent variable. Because the majority of observed variables in the work stress domain had factor loadings of lower than 0.50, r-square values were investigated (Appendix 1). While the r-square value of other variables in work stress was at least 0.095, r-square for psychological job demand was less than 0.50. As a result, psychological job demand was eliminated from the model.

Table 3-1. Confirmatory factor analysis of variables in men

Latent variables	Observed variables	Estimate	Standard error	Standardized estimate
Mental health	Cheerful and in good spirits	1.01***	0.010	0.87
	Calm and relaxed	1.02***	0.011	0.85
	Active and vigorous	1.05***	0.011	0.85
	Fresh and rested	1.03***	0.012	0.81
	Daily life filled with interesting things	1.05***	0.012	0.82
Health-risk behaviors	Alcohol drinking (gram/day)	12.47***	0.871	0.73
	Cigarette smoking (cig/day)	2.77***	0.203	0.41
Work stress	Psychological job demand	0.72***	0.045	0.22
	Decision latitude	1.30***	0.054	0.33
	Social support	2.41***	0.053	0.71
	Physical job demand	0.73***	0.033	0.31
	Job insecurity	0.67***	0.021	0.45

***p<.001 **p<.01 *p<.05 †p<.10

p-value(χ2)=0.000, CFI=0.92, TLI=0.90, NFI=0.92, RMSEA=0.082 (CI: 0.079-0.084)

3.3.2 Confirmatory factor analysis of variables in women

Table 3-2 also reports fit indices for confirmatory factor analysis in women, the results are identical to that of men (CFI=0.92, TLI=0.90, NFI=0.92, RMSEA=0.082 (0.079-0.084).

The standardized estimates for mental health ranged from 0.76 to 0.81 and were all significant at $p<0.001$. Being calm and relaxed and active and vigorous had the highest standardized estimates of 0.81, while being cheerful and in good spirits had the lowest standardized estimated with the value of 0.76. Being fresh and rested and daily life filled with interesting things had factor loadings of 0.75 and 0.77 each. The factor loadings for health-risk behaviors were higher than that of men, with 0.87 for alcohol drinking and 0.43 for cigarette smoking. Even though the factor loadings were low, all constructs of work stress were significant in men. However in women, the estimates for psychological job demand and physical job demand did not show any significance. The standardized estimates was 0.25 for decision latitude, 0.79 for social support and 0.43 in job insecurity. Nevertheless, cigarette smoking was not omitted from the whole model because it is one of the core constructs of the latent variable. Because the majority of observed variables in the work stress domain had factor loadings of lower than 0.50, r-square values were investigated. The r-square value for psychological job demand was extremely low with the value of 0.001 and 0.006 for physical demand

(Appendix 1). Since the r-square for physical demand in men were not extremely low, only psychological job demand was omitted in the modified model.

Table 3-2. Confirmatory factor analysis of variables in women

Latent variables	Observed variables	Estimate	Standard error	Standardized estimate
Mental health	Cheerful and in good spirits	0.89***	0.044	0.76
	Calm and relaxed	0.98***	0.043	0.81
	Active and vigorous	1.02***	0.045	0.81
	Fresh and rested	0.96***	0.047	0.75
	Daily life filled with interesting things	0.96***	0.046	0.77
Health-risk behaviors	Alcohol drinking (gram/day)	13.61***	1.983	0.87
	Cigarette smoking (cig/day)	2.60***	0.440	0.43
Work stress	Psychological job demand	0.11	0.165	0.03
	Decision latitude	0.98***	0.202	0.25
	Social support	2.87***	0.257	0.79
	Physical job demand	0.18	0.119	0.08
	Job insecurity	0.73***	0.090	0.43

***p<.001 **p<.01 *p<.05 †p<.10

p-value(χ2)=0.000, CFI=0.92, TLI=0.90, NFI=0.92, RMSEA=0.082 (CI: 0.079-0.084)

3.3.3 Modified confirmatory factor analysis of variables in men

After eliminating psychological job demand, since the variable does not have adequate correlation with other variables or work stress, confirmatory factor analysis was conducted once more to assess the fitness of the modified model. In table 3-3, the results of modified confirmatory factor analysis in men are presented.

The model fit indices fulfilled the requirements for construct validity. Compared with the initial model, all model fit indexes showed improvements. CFI measure increased from 0.92 to 0.96. Also, TLI value, which was not acceptable in the intial model, increased to 0.94, indicating acceptable model fit. The NFI measure also increased from 0.92 in the initial model, to 0.96 in the modified model. Along with other fit indices, RMSEA also suggested improved fit with the value of 0.066 (CI: 0.063-0.069). Whereas part of the model fit indices showed unacceptable model fit values, all used indices in the modified model showed acceptable model fit, indicating construct validity of the model.

All 5 observed variables in the mental health domain showed the factor loadings of over 0.80. Being cheerful and in good spirits had the standardized estimate of 0.87, being calm and relaxed and active and vigorous 0.85, daily life filled with interesting things 0.82 and feeling fresh and rested showed the value of 0.81. Moreover, the

factor loadings for health risk behaviors were 0.75 for alcohol drinking and 0.40 for cigarette smoking. As for the 4 observed variables in work stress, the lowest factor loading was on physical job demands with 0.23 and the highest factor loading was on social support with 0.80. The remaining 2 variables for work stress (decision latitude and job insecurity) they each had standardized coefficients of 0.31 and 0.44.

Table 3-3. Modified confirmatory factor analysis of variables in men

Latent variables	Observed variables	Estimate	Standard error	Standardized estimate
Mental health	Cheerful and in good spirits	1.01***	0.010	0.87
	Calm and relaxed	1.02***	0.011	0.85
	Active and vigorous	1.05***	0.011	0.85
	Fresh and rested	1.03***	0.012	0.81
	Daily life filled with interesting things	1.05***	0.012	0.82
Health-risk behaviors	Alcohol drinking (gram/day)	12.74***	0.907	0.75
	Cigarette smoking (cig/day)	2.71***	0.203	0.40
Work stress	Decision latitude	1.20***	0.053	0.31
	Social support	2.71***	0.061	0.80
	Physical job demands	0.54***	0.031	0.23
	Job insecurity	0.65***	0.021	0.44

***p<.001 **p<.01 *p<.05 † p<.10

p-value(χ2)=0.000, CFI=0.96, TLI=0.94, NFI=0.96, RMSEA=0.066 (CI: 0.063-0.069)

3.3.4 Modified confirmatory factor analysis of variables in women

As for the modified model in women, the results are presented in table 3-4. The model fit indices all showed acceptable fit.

The observed variables of mental health all showed significance with factor loading of 0.76 for being cheerful and in good spirits, 0.81 for being calm and relaxed and feeling active and vigorous. Feeling fresh and rested had a factor loading of 0.75 and daily life filled with interesting things had a factor loading of 0.77. Just as the initial model, the factor loading for health-risk behaviors were higher in women than in men, with 0.87 for alcohol drinking and 0.43 for cigarette smoking. Three observed variables of work stress showed significance at $p<0.001$ while physical job demands did not. Decision latitude had a factor loading of 0.24, social support had a factor loading of 0.79 and job insecurity had a factor loading of 0.43.

Table 3-4. Modified confirmatory factor analysis of variables in women

Latent variables	Observed variables	Estimate	Standard error	Standardized estimate
Mental health	Cheerful and in good spirits	0.89***	0.044	0.76
	Calm and relaxed	0.98***	0.043	0.81
	Active and vigorous	1.02***	0.045	0.81
	Fresh and rested	0.96***	0.047	0.75
	Daily life filled with interesting things	0.96***	0.046	0.77
Health-risk behaviors	Alcohol drinking (gram/day)	13.60***	1.982	0.87
	Cigarette smoking (cig/day)	2.61***	0.440	0.43
Work stress	Decision latitude	0.97***	0.202	0.24
	Social support	2.87***	0.258	0.79
	Physical job demands	0.17	0.119	0.07
	Job insecurity	0.73***	0.091	0.43

***p<.001 **p<.01 *p<.05 †p<.10

p-value(χ2)=0.000, CFI=0.96, TLI=0.94, NFI=0.96, RMSEA=0.066 (CI: 0.063-0.069)

3.4 Relationships between work stress, health-risk behaviors and mental health (Research model 1)

3.4.1 Relationships between work stress, health-risk behaviors and mental health in men (Research model 1)

After confirming the validity of the model through confirmatory factor analysis, paths between latent variables were identified. According to he research model 1, all three pathways 1) work stress → mental health. 2) work stress → health-risk behaviors and 3) health-risk behaviors → mental health were investigated.

The model fit indices presented in this study suggested good model fit except for chi-square statistics. However the sensitivity of chi-square statistics to sample size may have induced this result. The incremental fit indices, CFI, TLI an NFI were 0.93, 0.91 and 0.93. On the other hand, the RMSEA statistics, showed the value of 0.062 with the confidence interval ranging from 0.060 to 0.064)

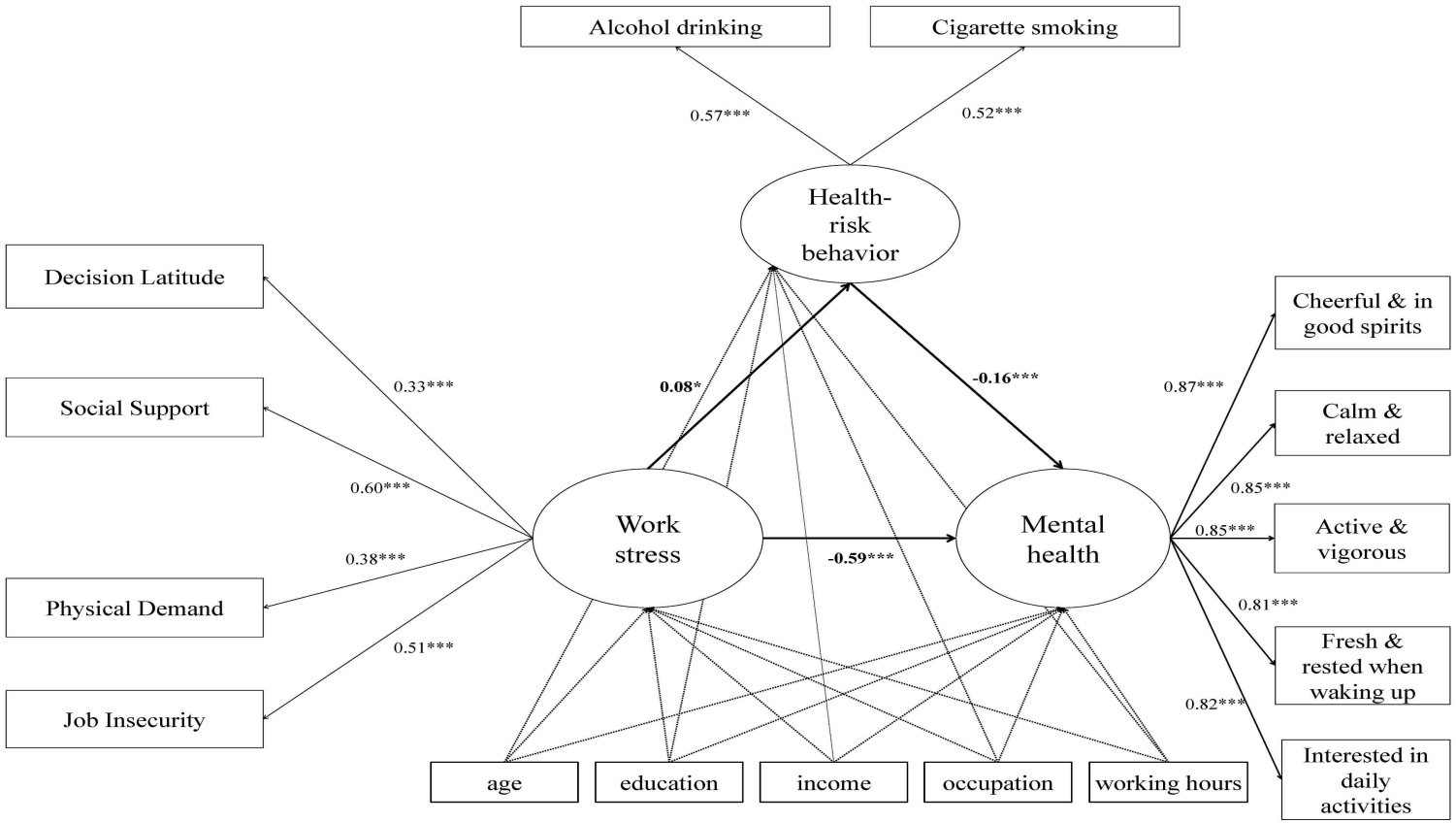
In table 4-1 and figure 3, the results of path analysis examining the first research model are illustrated. First of all, the relationship between work stress and mental health was found to be negative. The non-standardized regression coefficient was -0.50 ($p<0.001$), whereas the standardized coefficient was -0.59. This implies that high levels of work stress predict poor mental health conditions. Second, there

was a positive relationship between work stress and health-risk behaviors, in other words, the higher the work stress, the stronger the intensity of health-risk behaviors. The estimates of the path were 0.06 and 0.08 at $p<0.05$ for non-standardized and standardized values respectively. Finally, health-risk behaviors and mental health had a statistically significant negative relationship. The non-standardized estimate was −0.18 whereas the standardized estimate was −0.16. This result implies that high intensity of health-risk behaviors can have detrimental effect on the mental well-being of workers.

Table 4-1. Relationships between work stress, health-risk behaviors and mental health in men (Research model 1)

Pathway	Estimate‡	Standard error	Standardized estimate
Work stress → Mental health	-0.50***	0.027	-0.59
Work stress → Health-risk behaviors	0.06*	0.030	0.08
Health-risk behaviors → Mental health	-0.18***	0.024	-0.16

***p<.001 **p<.01 *p<.05 †p<.10
p-value(χ2)=0.000, CFI=0.93, TLI=0.91, NFI=0.93, RMSEA=0.062(CI:0.060-0.064)
‡:adjusted for age, educational level, income, occupational class and weekly work hours



<Figure 3. Relationships between work stress, smoking, drinking and mental health in men (research model 1)>

3.4.2 Relationships between work stress, health-risk behaviors and mental health in women (Research model 1)

Pathways from research model 1 have been adapted to examine the relationships between work stress, health-risk behaviors and mental health.

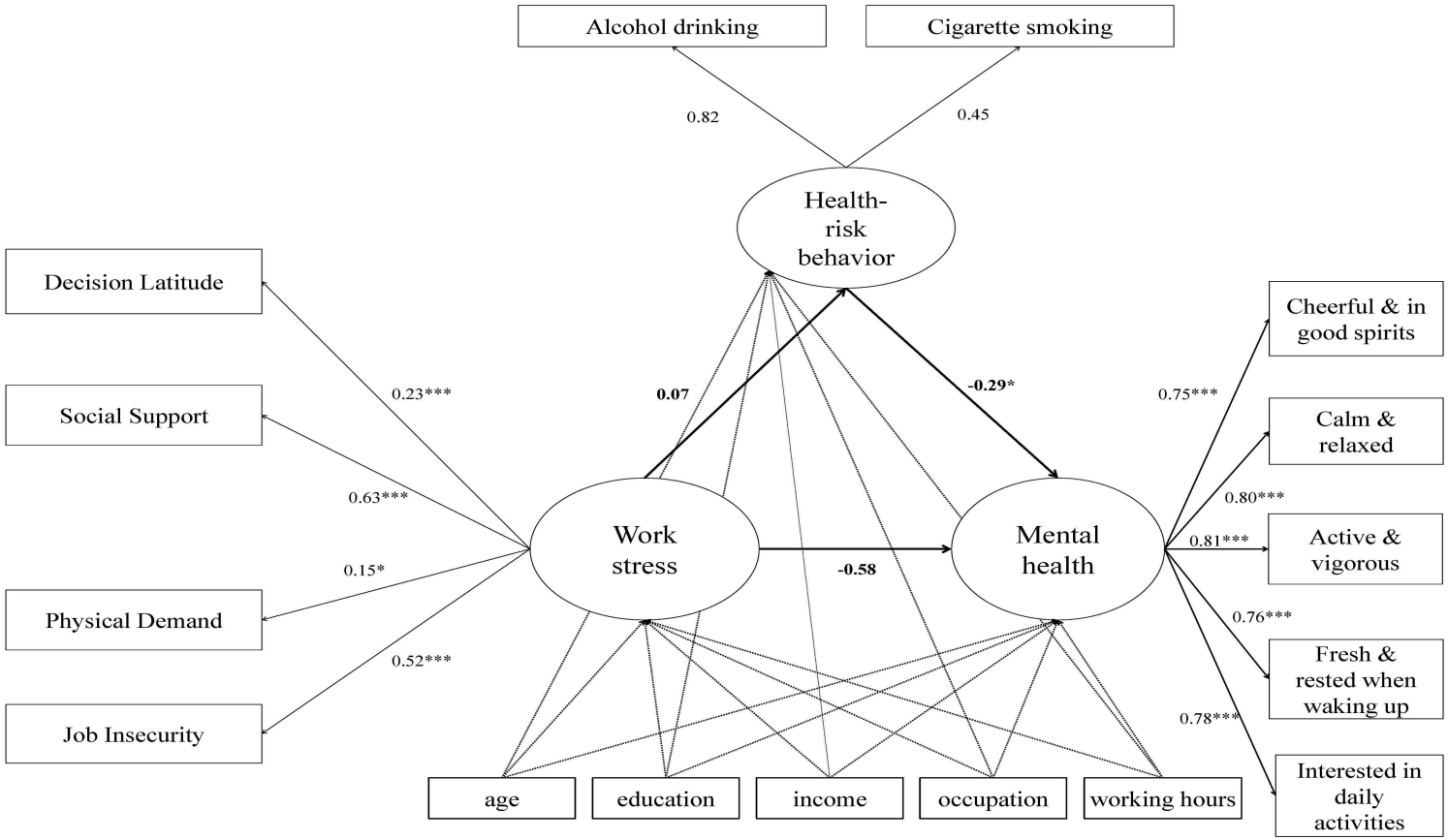
In table 4-2 and figure 4, the results of path analysis examining the first research model are presented. First of all, the association between work stress and mental health was found to be negative. The non-standardized regression coefficient was −0.69 and it was not significant, whereas the standardized coefficient was −0.58. Second, the relationship between work stress and health-risk behaviors was also not significant. The estimates of the path was 0.06 and 0.07 for non-standardized and standardized values respectively. Finally, health-risk behaviors and mental health had a statistically significant negative relationship. The non-standardized estimate was −0.37 whereas the standardized estimate was −0.29. This result implies that high intensity of health-risk behaviors can have detrimental effect on the mental well-being of workers.

Unlike the results in men, where all paths were significant, only the path of health-risk behaviors→mental health was significant.

Table 4-2. Relationships between work stress, health-risk behaviors and mental health in women (Research model 1)

Pathway	Estimate‡	Standard error	Standardized estimate
Work stress → Mental health	-0.69	1.237	-0.58
Work stress → Health-risk behaviors	0.06	0.129	0.07
Health-risk behaviors → Mental health	-0.37*	0.175	-0.29

***p<.001 **p<.01 *p<.05 †p<.10
p-value(χ2)=0.000, CFI=0.93, TLI=0.91, NFI=0.93, RMSEA=0.062 (CI:0.060-0.064)
‡:adjusted for age, educational level, income, occupational class and weekly work hours



<Figure 4. Relationships between work stress, smoking, drinking and mental health in women (research model 1)>

3.5 Mediation analysis

The direct and indirect effect of work stress on mental health has been calculated and presented in table 5.

The estimate for direct effect of work stress on mental health is −0.59 at $p<0.001$, whereas the estimate for indirect effect through health-risk behaviors is −0.01 at $p<0.05$, suggesting the estimate for total effect of −0.59. The results of the analysis indicate partial mediation of health-risk behaviors in the relationship of work stress and mental health.

Through the bootstrap procedure, which is a resampling of the original dataset, the confidence interval of the indirect effect has been calculated (CI :-0.021, -0.002). The confidence interval of the indirect effect suggest significance.

Table 5. Total, direct and indirect effect of work stress on mental health (Research model 1)

Pathway	Total Effect	Direct effect	Indirect effect	Proportion mediated (%)
Work-related stress → Mental health	-0.60***	-0.59***	-0.01* (CI: -0.021, -0.002)	2.2

***p<.001 **p<.01 *p<.05 †p<.10

3.6 Relationships between work stress, health-risk behaviors and mental health (Research model 2)

3.6.1 Relationships between work stress, health-risk behaviors and mental health in men (Research model 2)

Three pathways : 1) work stress → mental health. 2) mental health → health-risk behaviors and 3) health-risk behaviors → work stress were investigated while adjusting for the participants age, educational level, monthly income, occupational class, and average working hours per week.

Model fit indices have been tested to measure the appropriateness in the use of estimates given in the model. The model demonstrated acceptable model fit with CFI=0.93, TLI=0.91 , NFI=0.93 and RMSEA=0.062 (CI : 0.060-0.064). Due to the sensitivity of chi-square statistics to sample size, the chi-square statistics showed unacceptable fit (p-value=0.000).

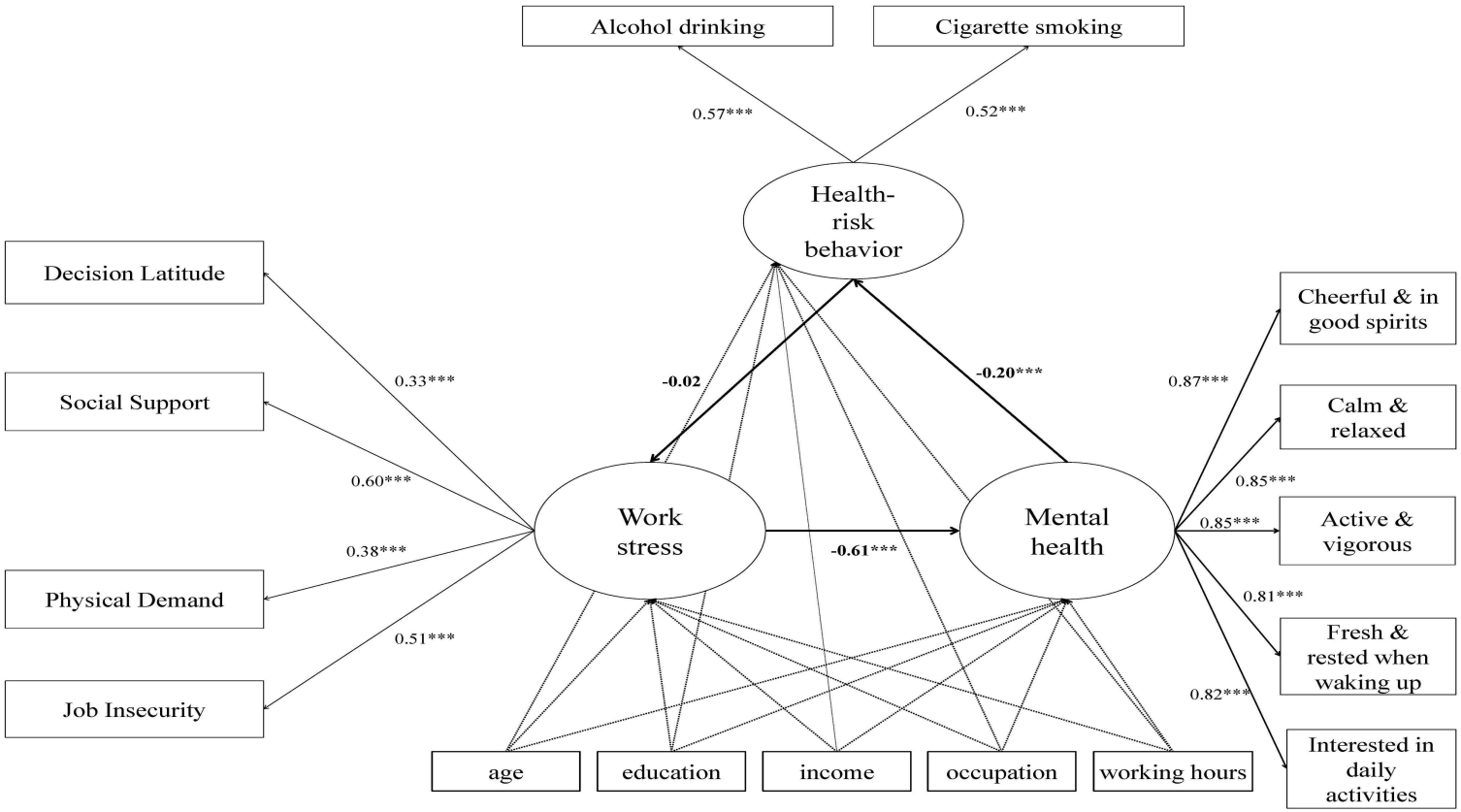
In table 6-1 and figure 5, the results of path analysis examining the second research model are presented. First of all, the relationship between work stress and mental health was found to be negative, similar to the result of the research model 1 in table 4-1, although there was a slight difference in the magnitude of the effect. The non-standardized regression coefficient was -0.51 ($p<0.001$), whereas

the standardized coefficient was −0.61. The standard error for this pathway was 0.027. The pathway from mental health to health-risk behaviors also have been found to be negative. The estimates of the path were −0.18 and -0.20. The standard error for this pathway showed the value of 0.024. Finally, the relationship between health-risk behaviors and work-related stress has been found to be non-significant.

Table 6-1. Relationships between work stress, health-risk behaviors and mental health in men (Research model 2)

Pathway	Estimate‡	Standard error	Standardized estimate
Work stress → Mental health	-0.51***	0.027	-0.61
Mental health → Health-risk behaviors	-0.18***	0.024	-0.20
Health-risk behaviors → Work stress	-0.03	0.035	-0.02

***p<.001 **p<.01 *p<.05 †p<.10
p-value(χ2)=0.000, CFI=0.93, TLI=0.91, NFI=0.93, RMSEA=0.062 (CI:0.060-0.064)
‡:adjusted for age, educational level, income, occupational class and weekly work hours



<Figure 5. Relationships between work stress, smoking, drinking and mental health in men (research model 2)>

3.6.2 Relationships between work stress, health-risk behaviors and mental health in women (Research model 2)

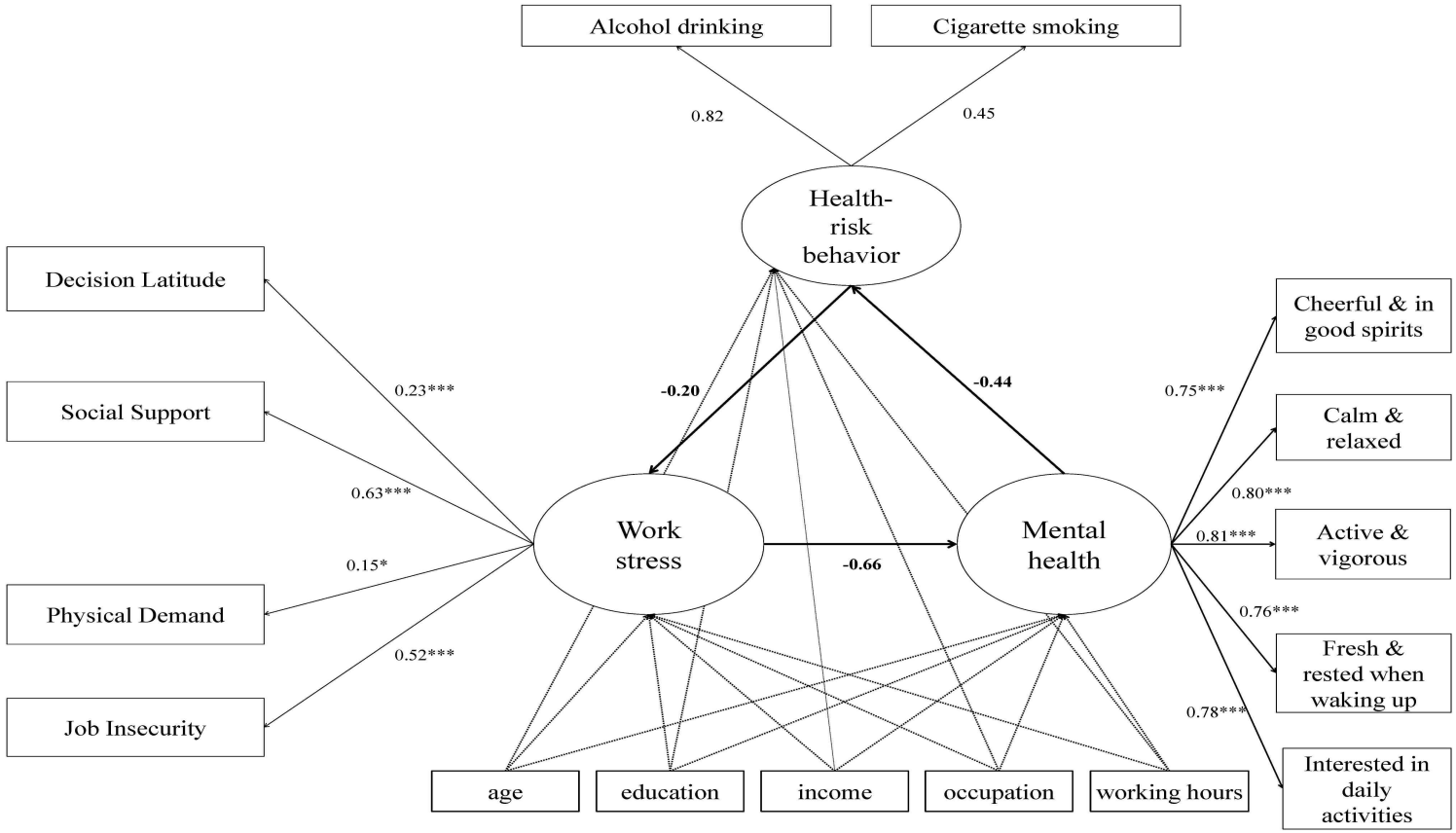
In the path analysis investigating the relationship between work stress, health-risk behaviors and mental health among women, the model fit indices proved to be acceptable (CFI=0.93, TLI=0.91, NFI=0.93 and RMSEA=0.062).

However, all of the paths tested in this analysis has been found to be non-significant. The pathway from work stress to mental health had an estimate of ⁻0.77, although it was not significant. The standard error for this pathway was 1.767. Also, the estimate for mental health → health-risk behaviors was found to be ⁻0.38 and not significant and the standard error for this pathway was 0.273. In addition, the effect of health-risk behaviors work stress on women's mental health was also not significant (B=-0.20).

Table 6-2. Relationships between work stress, health-risk behaviors and mental health in women (Research model 2)

Pathway	Estimate‡	Standard error	Standardized estimate
Work stress → Mental health	-0.77	1.767	-0.66
Mental health → Health-risk behaviors	-0.38	0.273	-0.44
Health-risk behaviors → Work stress	-0.20	1.243	-0.20

***p<.001 **p<.01 *p<.05 †p<.10
p-value(χ2)=0.000, CFI=0.93, TLI=0.91, NFI=0.93, RMSEA=0.062 (CI : 0.060-0.064)
‡:adjusted for age, educational level, income, occupational class and weekly work hours



<Figure 6. Relationships between work stress, smoking, drinking and mental health in women (research model 2)>

4. DISCUSSIONS AND CONCLUSIONS

4.1 Interpretation of the results

The current study explored the relationships between work stress, health-risk behaviors and mental health through structural equation modelling based on two research models. The discussion points are focused on the objectives that have been discussed previously : 1) confirming the relationship between work stress and mental health. 2) identifying the relationships of work stress and health-risk behaviors and 3) investigating the effect of alcohol drinking and cigarette smoking on the relationship of work stress and mental health.

Prior to identifying the relationships of the main study variables, the process of confirming the theoretical assumptions of the constructs has been conducted. The factor loadings for work stress were not consistent between men and women, they were different in the terms of magnitude and significancy. In men, all domains of work stress have been found to be significant whereas in women, the observed variable of psychological demand and physical demand were found to be inadequate to explain the latent variable of work stress. This may be due to the fact that women do not perceive psychological demand and physical demand as a stressful event. Also, there is a possibility that tasks that are psychologically or physically demanding may be

appointed to men rather than women. Previous studies have also pointed out that the domains that men and women are affected may be different (Stansfeld, Fuhrer, Head, Ferrie, & Shipley, 1997;Wang et al., 2008). Although the factor loading for psychological demand was significant in men, this path was eliminated from the final model because its r-square value was too small. On contrast, despite the non-significance of physical job demand in women, this variable was not omitted because it played a substantial role among men. No change was applied to the observed variables of mental health and health-risk behaviors.

The results of research model 1 and 2 demonstrated some interesting differences in perspective. The former findings (research model 1) reveal that employees' mental health is non only affected directly by work-stress but also indirectly by health-risk behaviors among men. In women, high intensity of health-risk behaviors predicted poor mental well-being. However, the effect of work stress on mental health and on health-risk behaviors has not been found significant. The latter findings (research model 2) also suggested the role of work stress on poor mental well-being in men. It has also been found that in men, mental health inversely predicted the intensity of health-risk behaviors. Unexpectedly, no significant relationship has been found among women in the analysis based on the hypothesis of research model 2.

The relationship of work stress and mental health shown in this

study is consistent with Wang, Lesage, Schmitz and Drapeau's (2008) finding that high level of job strain is associated with main depressive symptoms exclusively in men (Wang, Lesage, Schmitz, & Drapeau, 2008). Theoretically, the identity of men are more tied to their positions at work, while women's identity are more influenced by factors other than work, such as home and family life events (Griffin, Fuhrer, Stansfeld, & Marmot, 2002;Oman & King, 2000). This theory may serve as the answer to the question of why work-related stress is significantly associated with mental health in working men but not in women. Work-related stress, or psychosocial work environment as a risk factor for mental disorders has been established in a meta-analytic review conducted in 2006 (Stansfeld & Candy, 2006).

In addition, the impact of work stress on the intensity of health-risk behavior was found to be statistically significant only among men. Under stressful work conditions, men are more likely to engage in severe alcohol drinking and tobacco smoking behaviors. Although previous studies have shown different magnitudes regarding the causal relationship of work stress to health-risk behaviors (Green & Johnson, 1990; Greenlund et al., 1995;Hellerstedt & Jeffery, 1997; John, Riedel, Rumpf, Hapke, & Meyer, 2006;Johnson & Hall, 1988;Kuper & Marmot, 2003;Niedhammer et al., 1998, Otten, Bosma, & Swinkels, 1999;Shields, 1999;Steptoe, Wardle, Pollard, Canaan, & Davies, 1996). The structural equation model in this study shows that work stress has a significant effect on alcohol drinking and tobacco

smoking behavior. No significant path between work stress and health-risk behaviors among women may address the fact that even under stressful work conditions, women do not take behavioral measures such as alcohol drinking or cigarette smoking. Interestingly, in the second research model, high intensity of health-risk behaviors did not predict high work-related stress among both sexes. This result implies that engaging in alcohol drinking and cigarette smoking do not change the employees' perspectives of the working environment.

Moreover, in research model 1, high-intensity of health-risk behaviors predicted poor mental well-being in men and women. The magnitude of prediction was larger in women. Similarly, in the second research model, good mental health illustrated the possibility of low intensity of health-risk behaviors. The results in research model 1 and 2 imply the possibility of bidirectional mechanisms, thus suggesting the overestimation of effect in the relationship between health-risk behaviors and mental health status. The bidirectional pathway has been discussed by a number of literatures over the years, in both alcohol drinking (Gilman & Abraham, 2001;Schuckit, 1983) and cigarette smoking (Kendler et al., 1993;Paperwalla, Levin, Weiner, & Saravay, 2004).

In the comparison of research model 1 and 2, similarities and differences have been found at once. The model fit indices of the models could not be distinguished because they are considered "equivalent" in a structural equation model (Stelzl, 1986). However, it

seems more rational to support the explanation in the first research model. The reasons are the following, standing back from the results of women, where majority of the paths were found to be not significant, all paths hypothesized in research model 1 among men have been found to be significant, whereas the path of health-risk behaviors → work stress in research model 2 has been proved to be insignificant. Nevertheless, it must be addressed that the relationship between health-risk behaviors on mental health may act on two directions. Also, the general pathway suggested by researchers in explaining the relationship between work-related stress and health is concordant with the first research model. In theory, two pathways have been suggested to explain the mechanisms concerning work stress and mental health. First, one acting directly through the organism's stress receptor and second, acting as an "indirect" mechanism operation through behavioral change (Ko, 2002), these behavioral change include cigarette smoking, excessive alcohol consumption, excessive energy intake and lack of physical exercise.

According to the stress-appraisal-coping theory proposed by Lazarus and Folkman, when an person encounters some form of stressors, the individual goes through a number of processes (Lazarus & Folkman, 1984). First of all, individuals go through the process of evaluating if the stressor is harmful to his or her's well-being. This is called the appraisal. Afterwards, the effort to cope with this stressor can be made. Coping can be characterized by two major functions: regulate

emotions induced by stress (emotion-focused coping) or make changes in the environment that has caused the stressful event (problem-focused coping) (Lazarus & Folkman, 1984). The use of both coping forms has been supported strongly. For example, over 95% of the middle-aged and college students were found to use both forms in a stressful event (Folkman & Lazarus, 1980; Folkman and Lazarus, 1985). Each individuals show different coping behaviors and depending on the appropriateness of the coping strategy, different outcomes can be induced. If employees use appropriate coping strategies, minimum stress responses along with the belief of being able to overcome the problems next time they encounter them can be acquired. Nevertheless, in the use of inappropriate coping such as smoking or drinking, which can be characterized as avoidance and numbing, ill outcomes can be induced. The result of this study implies that smoking and drinking is an inappropriate measure to take when trying to cope with stressors.

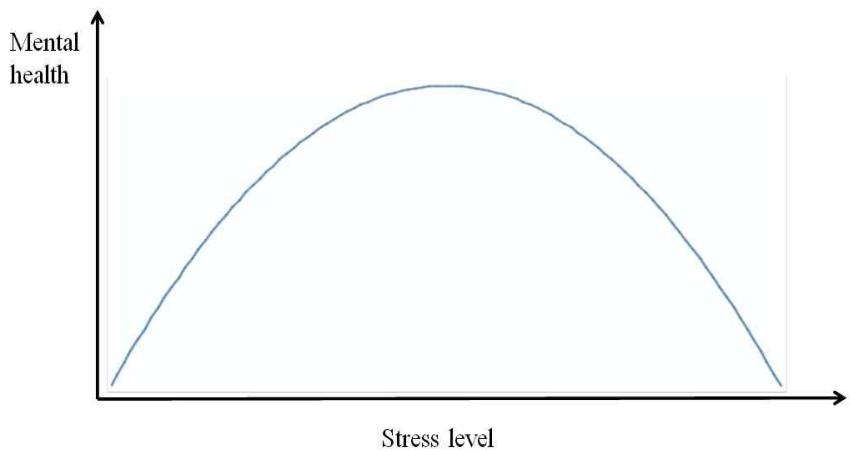
As an implication of this study, workers' perception of health-risk behaviors as means of stress-relief agent must be reconsidered and other strategies that can promote not only the mental health but physical health of workers must be developed. Because workplace is where adults spend most of their daytime, the effect of programs against cigarette use or alcohol abuse can bring great results. Health promotion programs in the worksite are considered appropriate and beneficial. This is because 1) high participant rates can be obtained 2)

effective programs can be developed as the participants are limited and specific and 3) long-term intervention is suitable as the majority of workers stay in one workplace for a long period of time (Lee, 2007). On the basis of public health, interventions are normally classified as primary, secondary or tertiary. In a primary intervention aiming for work-related stress, the target of intervention is work stress it-self (Landsbergis, 2003). Therefore, primary intervention is achieved through task redesigning, reduction of work load and improvement of communication (LaMontagne et al., 2007). In other words, conditions that play roles as stressors such as bad skilled superiors and less autonomy when conducting tasks must be modified in a primary intervention. Although primary intervention is the most effective of all, it is costly and generally difficult to achieve in the real world. Secondary interventions can be described as ameliorative measures. This level targets the employees' reactions to stressors. As a part of secondary intervention aiming for work stress in the workplace, workers must be educated with the information that smoking and drinking cannot be considered as a coping strategy to stress. From the results of the study, it has been presented that social support in the workplace is a main construct of work stress. Therefore, approaches such as creating an atmosphere of not drinking or smoking under stressful conditions in the workplace and providing opportunities for workers to bond with each other can be effective. Numerous studies have found workplace as an useful setting for helping people to quit smoking and reduce alcohol consumptions (Cahill & Lancaster, 2008;

Cook, Back & Trudeau, 1996). Finally, tertiary interventions aim to minimize or reduce the work stress-related health effects. The tertiary intervention include activities such as counselling in the workplace and rehabilitation programs at work. Out of the three types of interventions that can be used, primary interventions are the most effective, followed by secondary and tertiary interventions. Secondary interventions are less effective that the primary intervention, but they are far more easily achieved. Therefore, the rule of thumb may be secondary intervention when tackling work-related stress.

This study has some limitations. First, although the models specify causal relationship between variables, the models are in cross-sectional nature, therefore careful interpretation of the results must be given. Second, this study attempted to replicate the dimensions of the demand-control-support model (Karesek, 1979;Johnson & Hall, 1988), however it has failed to obtain a complete, and validated measures of the model. As a result, the construct validity for work stress seems weak. However, several studies identified job strain without using the exact variables from Karesek's Job Content Questionnaire (JCQ) (Canjuga, 2010; Debrand and Lengagne, 2007; Landsbergis, Cahill and Schnall, 1999). Also, this study has assumed linear relationship between work stress and mental health. However, some studies support the non-linear relationships between these two variables. For instance, Warr (1994) has an opposing position to the linear relationship between work stress and mental health, instead he

suggests curvilinear relationship of job characteristics and mental health of employees (Warr, 1994). That is, for low to medium levels of stress, the mental health of employees can actually improve, however, if the stress exceeds medium level, negative relationship of work stress and mental health is expected (Figure 7).



<Figure 7. Warr's vitamin model>

If the nature of relationship between work stress and mental health is in fact curvilinear, the strength of relations may have been underestimated.

Despite the limitations, this study also has several strengths, first of all, the structural equation model applied in this study has the ability to uncover the underlying relationships between variables by taking account of the non-observed characteristics of participants. The nature of models using latent variables allow researchers to capture the hidden relationships between variables more accurately. In

addition, two research models have been presented and analyzed to identify more accurate relationships between work stress, health-risk behaviors and mental health. The WHO-5 Well-being Index is a validated measure to assess mental health conditions. Also, this study has an advantage in that it used a subset of a nationwide survey and has large samples over 8,000 participants. Therefore, the outcomes of this study can also be applied to the general working population of Korea.

4.2 Conclusion

The results of this study show that work stress can be a determinant for poor mental health through both direct and indirect pathway via health-risk behaviors based on the examination of two research models.

In contrary to the belief that alcohol drinking or tobacco smoking can be used as means of stress relief, this study reveals that the perception of health-risk behaviors as a stress mediating agent is not true.

Although it has been confirmed once again that work-related stress have negative influence on the mental health of workers, reducing stress itself by taking structural measures in the work organization are practically difficult to achieve. Therefore, appropriate coping strategies to promote the health of workers must be introduced. Worksite based stress coping strategies such as coping classes or anger management program have been found to be effective, therefore, more programs on health promotion of workers should be developed and be applied.

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Appendix 1. R-square for the observed variables

	Men	Women
	R-square	R-square
Cheerful and in good spirits	0.758	0.571
Calm and relaxed	0.725	0.650
Active and vigorous	0.728	0.656
Fresh and rested	0.657	0.565
Daily life filled with interesting things	0.665	0.594
Alcohol drinking (gram/day)	0.532	0.756
Cigarette smoking (cig/day)	0.167	0.182
Psychological job demand	0.048	0.001
Decision latitude	0.109	0.061
Social support	0.509	0.622
Physical job demand	0.095	0.006
Job insecurity	0.206	0.182

SUMMARY IN KOREAN

국문초록

직무스트레스와 흡연·음주 및 정신건강의 구조적 관계

강희원

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연구배경 : 직장은 인간의 삶에서 가장 중추적인 장소 중 하나이다. 우리나라 근로자들은 높은 직무스트레스를 경험하는 것으로 알려져 있으며, 이는 근로자들의 정신건강에 대한 위협이 된다. 또한, 근로자들은 높은 직무스트레스에 대처하기 위해 흡연이나 음주와 같은 건강위험행위를 하는 경향이 있다. 이는, 흡연 또는 음주가 긴장을 완화시켜 준다는 강한 믿음으로부터 기인한다. 현재까지 직무스트레스와, 건강위험행위 그리고 정신건강의 관계를 분석한 연구들에서 일관적이지 않은 결과들이 제시되었다. 잠재변수를 사용하는 구조방정식 모형은, 자료에서 측정되지 않은 대상자들의 차이를 고려하여 변수 사이의 숨겨진 관계를

파악하는데 사용될 수 있다. 따라서 본 연구에서는, 구조방정식 모형을 이용하여 직무스트레스와 건강위험행위 그리고 정신건강 사이의 관계를 파악하고, 이 결과를 근로자의 정신건강 및 신체건강 증진에 사용하고자 한다.

연구방법 : 본 연구는 2011년도에 수행된 제 3차 근로환경조사 자료의 일부를 이용하였다. 직무스트레스와 건강위험행위 그리고 정신건강 사이의 관계를 파악하기 위하여 구조방정식 모형을 도출하였다. 연구 변수들 사이의 보다 정확한 관계를 파악하기 위하여 두 개의 연구모형이 제시 되었다. 연구 모형 1은 매개모형으로, 직무스트레스가 독립변수, 건강위험행위가 매개변수 그리고 정신건강 수준이 종속변수로 설정되었다. 반면, 연구 모형 2에서는 순환 모형이 제시 되었다 (직무스트레스 ⇝ 정신건강 ⇝ 건강위험 행위 ⇝ 직무스트레스). 측정모형 평가를 위해 확인적 요인 분석을 시행하였으며, 구조모형 평가를 위해 경로분석을 시행하였다. 또한, 직무스트레스와 정신건강의 간접효과를 측정하기 위해 부트스트래핑(bootstrapping)을 통한 매개분석이 시행되었다.

연구결과 : 본 연구의 결과에 따르면, 직무스트레스는 연구 모형 1과 연구 모형 2에서 남성의 정신건강에 대한 위험요인으로 나타났다 (연구모형 1 : β=-0.59, 연구모형 2 : β=-0.61). 높은 직무스트레스 수준은 남성에게서 흡연량 및 음주량 증가를 일으키는 것으로 나타난 반면 (β=0.08) 여성에서는 차이가 없었다. 반면에, 높은 강도의 건강위험행위는 낮은 정신건강 수준과 관련이

있는 것으로 남성(β=-0.16, p<0.001)과 여성 (β=-0.29, p<0.05) 모두에게 나타났다. 남성에 있어서 흡연량 및 음주량 증가는 정신건강에 부정적인 효과(β=-0.20) 를 미치는 것으로 파악되었다. 직무스트레스와 정신건강의 사이의 관계에서 건강위험행위는 p<0.05에서 간접효과를 나타내었다.

결론 : 우리나라 근로자의 직무스트레스를 효과적으로 중재하기 위하여, 스트레스 해소전략에 대한 인식 제고가 필요하다. 또한, 근로자의 특성에 맞는 효과적인 스트레스 대처전략 방안 개발 및 적용을 통하여 근로자의 정신건강 및 신체건강의 증진이 이루어져야 한다.

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주요어 : 직무스트레스, 건강위험행위, 흡연, 음주, 정신건강, 구조방정식 모형

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